MONTHLY WEATHER REVIEW,

JULY, 1877.

WAR DEPARTMENT,

Office of the Chief Signal Officer,

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

INTRODUCTION.

The present Review for the month of July depends on all data received up to the 14th of August from the Canadian Meteorological Service, the United States Navy, the Army Post Surgeons, Voluntary Observers and the United States Signal Service. The most interesting features have been: First, The few storms reported at sea. Second, The unusually large number of tornadoes occurring the first ten days of the month. Third, The general diminution of grasshoppers and locusts, and the slight amount of damage done by them as compared with the several years previous.

BAROMETRIC PRESSURE.

In General.—The general distribution of barometric pressure for the month is shown by the isobars on chart II, from which it will be seen that the highest pressure has been off the South Atlantic and Gulf coasts, both of these districts being included in the isobar of 30.00. The pressure has diminished very regularly from the coast in a northwest direction to Dakota, where the lowest average for the month will probably be found. There has been a general deficiency of pressure in comparison with past years, which is most marked in the South Atlantic States and the least marked in the Northwest. In the Rocky Mountains the deficiency has been about .04 of an inch, and nearly the same on the Pacific slope.

Barometric Range.—The general range of the barometer over the whole country east of the Rocky Mountains was about 1.03 inches, as may be seen from the following table, which gives the maximum and minimum pressures that occur on the tri-daily maps near the centres of the respective areas of high and low barometer:

LOW AREAS.				HIGH AREAS.			
No.	Location.	Date.	Minimum Pressure.	No.	Location.	Date.	Maximum Pressure.
I	Lake Huron	July 1st, 7:35 a. m	29.45	I	South Atlantic States	July 1st, 7:35 a. m	30.17
II	Upper Mississippi val	July 2nd, 4:35 p. m	29.56	II	Norfolk	July 8th, 7:35 a. m	30.15
III	Lower Missouri valley	July 6th, 4:35 p. m	29.46	III	South Atlantic States	July 15th, 7:35 a. m	30.14
IV	East Gulf States	July 10th, 4:35 p. m	29.80	IV	Toronto	July 23rd, 7:35 a. m	30.30
V	Lower Missouri valley	July 14th, 4:35 p. m	29.28	V	Halifax	July 28th, 7:35 a. m	30.17
VI	Lower Lakes	July 19th, 7:35 a. m	29.48	VI	Montgomery	July 28th, 7:35 a. m	30.16
VII	Manitoba	July 27th, 4:35 p. m	29.53	VII	Quebec	July 31st, 4:35 p. m	30.20
VIII	Lower Missouri valley	July 30th, 4:35 p. m	29.27				

The greatest local barometric ranges have been as follows: 0.94 at Bismarck and North Platte; 0.86 at Alpena, and 0.82 at Escanaba.

The least local barometric ranges have been: 0.29 at Galveston; 0.32 at Indianola; 0.35 at New Orleans, Vicksburg, Memphis and Mobile.

Areas of High Pressure in General.—The areas of high pressure have been of two kinds—partly encroachments of the high summer barometer that prevails over the North Atlantic Ocean and partly due to areas of cold dry air flowing from the great plateau east of the Rocky Mountains and closing up the rear of the low pressures that have crossed the country during the month.

No. I—Was a continuation of the high pressure No. VIII of June, which, on the morning of the 1st, was highest in the South Atlantic and Gulf States, where it ranged above 30.10. This pressure slowly diminished, with southerly winds, disappearing as a high area during the 5th and 6th.

No. II.—The barometer rose slowly in rear of low pressure No. II in the Lake region during the night of July 3rd and 4th. This high area gradually moved to the eastward until the 7th, when it slowly extended itself along the Atlantic coast, giving rise to southerly winds preceding the development of low barometer No. III. It gradually moved to the Gulf States and disappeared as a high pressure on the 9th.

No. III.—This high pressure first appeared in Manitoba on the 9th, in rear of low barometer No. III; it remained nearly stationary until the 10th, when it moved in a southeasterly direction over the Lake region, Tennessee and the Ohio valley; on the 14th, it had extended over the South Atlantic States, where the pressure rapidly rose, giving rise to southerly winds preceding the development of low barometer No. V; from that day it gradually diminished as a high pressure, and on the 18th disappeared.

No. IV.—The pressure rose rapidly in the Northwest during the 19th, in rear of low barometer No. VI, and extended southerly to the Gulf and gave rise to "northers" in Texas on the 20th and 21st; it then moved easterly until, on the morning of the 23rd, the isobar of 30.20 extended over the Upper Mississippi valley, Lake region and Middle States, with the general pressure remarkably high for the month; on the morning of the 24th, the isobar of 30.20 had slowly moved to the east and south; from that time it slowly diminished, with southerly winds, while extending over the South Atlantic and East Gulf States until the afternoon of the 26th, when it ceased to exist as a high area.

No. V.—The pressure rose rapidly in Nova Scotia on the 27th, remained high until the 28th, and then diminished, with southerly winds, in advance of low barometer No. VIII.

No. VI.—The pressure rose slowly in the South Atlantic and Gulf States on the 27th and 28th, during the progress of low barometer No. VIII to the east, and disappeared, with southerly winds, on the 29th.

No. VII.—The pressure rose in the Lake region on the 30th in the rear of low barometer No. VII and moved in an easterly direction over Canada, and on the 31st extended over the New England and Middle States, giving rise to the cold northeast winds that prevailed at that time. The rest of the history of this pressure belongs to the August Review.

Areas of Low Pressure in General.—Eight areas of low pressure are given in the following list, only six of which, however, were sufficiently defined to have their tracks charted. In general the storm paths lie more to the north than for any year since the paths have been traced in this office. It has not been possible, with the insufficient data at hand, to determine whether or not any well-defined low area has moved from the Pacific coast over the Rocky Moutains, although there are several instances when the pressure has been low on the Pacific slope two or three days in advance of depressions becoming manifest in the extreme Northwest and Manitoba.

No. I.—This depression was referred to in the June REVIEW as No. XII, and its path charted until 11 p. m. of June 30th. On the 1st of this month the lowest pressure was central north of Lake Huron; rain prevailed, with warm southerly winds, in the Lake region, Canada, Middle and New England States, and cold north winds were blowing in the Upper Mississippi valley, with clearing weather. At 4:35 p. m. of the 1st the centre of the storm had advanced rapidly to the eastward, and was nearly north of Lake Ontario. On the morning of the 2nd the lowest pressure was near the mouth of the St. Lawrence river; in its rear this depression was rapidly closed up by cold northwest winds and clearing weather. The heaviest rain-falls on the limits of the map were in the Middle and New England States, and occur in the southeast quadrant of the low pressure; its path for July is charted entirely in Canada.

No. II.—This depression apparently originated in the high plateaus east of the Rocky Mountains and west of the Upper Missouri river. On the afternoon of the 1st it was central in Dakota. At 4:35 p. m. of the 2nd, the lowest pressure had advanced eastward and was central near Duluth. Warm southerly winds, with light rain, prevailed in the Lake region. On the afternoon of the 3rd the depression had moved in a southeasterly direction into the Lower Lake region, and then progressed over the Middle and New England States; and on the 4th it disappeared off the coast of the latter district. The rain-fall in the eastern portion of its track was much more general and heavy than in the Northwest, where there was a decided deficiency in precipitation; its progress was not marked with very decided changes of temperature or by very high winds; its track east of the Lake region was the most southerly of any during the month.

No. III.—This depression apparently was developed in Dakota during the 5th and 6th instants, due to the prevalence of the southerly winds in the plateau west of the Mississippi river, that had been constantly blowing in that direction from the Gulf of Mexico since the 1st of the month. At midnight of the 6th, the winds immediately east of the Rocky Mountains had shifted to colder northwest. On the afternoon of the 7th, the lowest barometric pressure extended like a trough from Lake Superior to Kansas, and for the next two days opposing warm southerly and cold northerly winds prevailed on the opposite sides of this depression over the country from the Lake region to the Indian Territory. At 7:35 a. m. of the 9th, the barometer was lowest near Lake Ontario; from that time the depression moved rapidly to the northeast, and on the 10th, disappeared in the Gulf of the St. Lawrence. This depression was chiefly remarkable for the destructive tornadoes that occurred in the West; for the heavy rain-fall in Kansas, occasioning destructive floods in the Missouri valley. The heaviest rain-falls accompanying this depression were in its southwest quadrant, occurring after the veering of southerly winds to west and north.

No. IV.—The barometer fell on the 10th, in the South Atlantic and Gulf States, to the south of high area No. III; it was accompanied by general and heavy rain-fall in those districts, but by slight changes in temperature and no high winds. There is no evidence of the translation of this area, and no path is charted.

No. V.—On the 13th, the winds in the Northwest shifted to southeast in advance of depression No. V, whose centre at 7.35 a. m. of the 14th is charted in Dakota. On the afternoon of the 15th this depression extended in a barometric trough from Lake Superior to west Texas, with opposing north and south winds. The rain-fall was light and unusually near the centre of the depression. The storm was followed by a marked fall in temperature; the centre is charted at 4.35 p. m. of the 15th, in Lake Superior; from that time there was no apparent translation of the depression. The barometer remained low in this region until the 17th, when its place was filled by the depression charted as low barometer No. VI.

No. VI.—This depression was probably developed in British America, east of the Rocky Mountains, during the 15th and 16th, in advance of the high pressure that was on the North Pacific coast at that time. On the 18th, this depression moved in a southerly direction, and at 4.35 p. m. the barometer was lowest in Southern Michigan; it remained lowest in the Lower Lake region until the 19th, and then moved rapidly up the St. Lawrence valley, with a track too indefinite to chart after the 20th instant. This was one of the most southerly storms of the month, and after the 17th, it became the best defined as a cyclone; it was rapidly followed by high area No. IV. During its progress very heavy and frequent rains fell east of the Mississippi river. There was a decided deficiency of precipitation in the Northwest. The rain fell in the greatest abundance in the southwest quadrant of the depression, as is frequently the case in the summer months.

No. VII.—A continued trough-like depression existed in Manitoba, Dakota, and the extreme Northwest from the 24th of July until the 27th, in rear of high pressure No. IV; it had no track that, with the data in the possession of this office, can be charted up to that time, but on the morning of the 27th its centre can be placed to the east of Pembina. It moved slowly to the southeast in the Lower Lake region, and, on ths 29th, took a path slightly to the north of the St. Lawrence river, and probably disappeared off the coast of the British maritime provinces in the early days of August. It was attended by numerous local but not heavy rains over the Lake region and New England States; heavy rain fell at the same time in Texas between the high area in the Gulf States and the high pressure in rear of this depression, moving in a southerly direction over the plains.

No. VIII.—At 7:35 a. m. of the 28th, a marked fall of the barometer took place in Manitoba and Dakota. By the 31st the winds immediately east of the Rocky Mountains had shifted to colder northwest. By the end of the month the depression was not sufficiently defined to have its track charted. But little rain fell. Its further history belongs to the August REVIEW.

Vessels Experiencing Storms at Sea.—4th, off Chincoteague, a revolving gale; 21st, N. 50° 35′, W. 19° 25′.

TEMPERATURE OF THE AIR.

In General.—The general distribution of temperature for the month is shown by the isotherms on chart No. II. A comparison with the averages for July during the past seven years shows that the temperatures have been about normal in the St. Lawrence valley, New England, Ohio valley, Tennessee and Upper Mississippi valley; slightly above the average in the Middle, South Atlantic and Gulf States, Lake region and Pacific coast.

Monthly mean temperatures, at special points, have been as follows: Mt. Washington, 49°.2; Pike's Peak, 39°.1.

Maximum and Minimum Temperatures.—Maximum temperatures, at Signal Service stations, above 95°, were reported as follows: 96°, Bourne, Cheyenne, Galveston, Keokuk, La Crosse, Lynchburg, Memphis,

Nashville, New Orleans, Pittsburgh and Yankton; 97°, Fort Gibson, Indianola, St. Louis and Wilmington; 98°, Salt Lake City, Smithville and Washington; 99°, Denver, Fort Sill, Norfolk, Omaha, St. Marks, Tybee Island, Vicksburg; 100°, Augusta, Charleston, Concho, Denison, Jacksonville, Mason, Mobile and Sanvanah; 101°, Dodge City; 102°, Corsicana and Montgomery; 103°. Sacramento; 104°, Laredo and Winnemucca; 106°, Brackettville and Boise City, Idaho; 107°, North Platte; 109°. Fort Sully and Rio Grande; 112°, Maricopa Wells; 113°. Yuma. Minimum temperatures below 40°: 23°, Pike's Peak; 34°, Mt. Washington; 37°, Winnemucca; 38°, Virginia City. The maximum temperatures for the month may be divided into three periods, the first of which occurred from the 4th to the 8th, and was generally distributed over the country to the southwest of a line drawn from North Carolina to Minnesota; the second occurred from the 15th to the 18th over the Lake region, Upper Ohio valley and Maine; and the third from the 25th to the 30th in the Atlantic coast States, Lower Lake region and lower Michigan.

Ranges of Temperature.—The largest diurnal ranges have been: 36° at Yankton and 38° at Pembina, 28th; 39° at Breckenridge, 29th, and Sacramento, 7th; 42° at Brackettville, 22nd; 54° at Winnemucca, 28th.

The largest monthly ranges have been: 51°, Detroit, Dodge City and Sacramento; 52°, Yankton and Stockton; 53°, Cheyenne; 55°, Brackettville and Maricopa Wells; 61°, Fort Sully; 62°, North Platte; 65°, Campo; 67°; Winnemucca.

Frosts were observed as follows: 30th and 31st, Camp Halleck, Nev.; 31st, Coalville, Utah, killing tender vegetation. Frosts at Summit, Col., nightly.

Ice.—The formation of ice, rather than frosts, was reported from Fort Sanders, Wy. Ty., on the 31st. Ice at Summit, Col., quarter of an inch thick night of July 31st and August 1st.

PRECIPITATION.

In General.—The general distribution of rain for the month is shown on chart No. III. The region of heaviest rain-fall is seen to extend along the East Gulf, South and Middle Atlantic coasts, while over the entire country east of the 100th meridian the rain-fall has been quite evenly distributed. Areas of light rain-fall are, however, seen to exist in the interior of South Carolina and Georgia; in Texas and Indian Territory; in lower Michigan and Canada; and from eastern Iowa westward. Rains have fallen at almost all stations situated in the Rocky Mountain region and along the Pacific coast, but the amounts reported are generally quite small. The table of comparative values, given on chart No. III, shows the rain-fall to be near the normal in nearly all the districts, excepting in the Middle and South Atlantic States, where an excess of one inch and a quarter is reported, and in the St. Lawrence valley, where a deficiency of about three-fourths of an inch is reported.

Special Heavy Rains.—The following are the most notable cases of heavy rains that have been reported 1st, North Volney, N. Y., 2.90 inches; Biddeford, Me., 8 inches in 3 hours; New London, Conn., 1.15 in 2½ hours; Oswego, N. Y., 3.57 in.; Utica, N. Y., heaviest rain-fall for years. 5th, Breckenridge, Minn., 2.02. inches in 1½ hours. 7th, Marquette, Mich., 1 inch in 30 minutes, Breckenridge, Minn., 2.00 in. in about 20 minutes during a hurricane. 8th, La Crosse, Wis., 2.69. 10th, Sandy Springs, Md., 0.60 inch fell in 15 minutes; Savannah, Ga., 2.80 in 4½ hours. 15th, Guttenburg, Iowa, 2.02 inches fell in 35 minutes; Cleaveland, Tenn., 3.1 inches fell in 1 hour 20 minutes. 16th, Alpena, Mich., 1.36 in.; Brackettville, Tex., 2.49 in.; Merom, Ind., 5.91 inches. 17th, Independence, Kan., 3.37 inches. 18th, Ft. Sill, Ind. Ter., 1.74 in.; Louisville, Ky., 2.64 in. 20th, Atlantic City, 2 14 in.; 20th, 21st and 22d, Cape Lookout, N. C. 5.69 in.; Cape Hatteras, 6.01 in.; Charleston, 7.33 in.; Wilmington, N. C., 6.87. 24th, Baltimore, 1.28 in 1 hour. 26th, Ft. Sill, Ind. Ter., 1.97 in. Rochester, N. Y., 2.05 in. 29th, Ft. Whipple, Va., 2.34. 30th, Trenton, N. J., 1.00 inch fell in 40 minutes; Hulmerville, Pa., 1.15 inch fell in 35 minutes; Bismarck, Dak. Ter., 0.45 in. in 30 minutes; 31st, Iowa City, Iowa, 2.50 inches fell in 1 hour.

Small Monthly Rain-falls.—The following stations report less than 0.5 of an inch: in California, Arizona and the Rocky Mountain region; San Francisco, .02; Sacramento and San Diego, .00; Wickenburg, .18; Stanwix, .13; Winnemucca, .27; Salt Lake City and Fort Fred Steele, .08; Cheyenne, .43; Denver, .33.

Large Monthly Rain-falls.—Rain-falls to the amount of seven inches or more were reported as follows: Cape Lookout, 8.78; Charleston, 10.21; Keokuk, 7.06; Mt. Washington, 11.27; Norfolk, 7.97; St. Marks, 8.72; Wilmington, 9.35; Cape Hatteras, 9.80; Milford, Del., 7.90; St. Mary's, Ga., 7.65; Milford, Ind., 7.69; New Orleans, 7.50; Trenton, N. J., 7.40; Vineland, N. J., 7.12; Moorestown, N. J., 7.43; Goldsboro, N. C., 7.56; Weldon, N. C., 7.76; Attaway Hill, N. C., 7.18; Hulmeville, Penn., 9.38; Cleaveland, Tenn., 7.90; Prospect Hill, Va., 8.90; Utica, Wis., 8.30.

Droughts.—Droughts, injurious to vegetation, have been reported as follows: Illinois—Carbondale,

drought during the month; Anna, on the 11th, relieved by subsequent rains. Massachusetts—Waltham, drought towards end of month. Texas—Clarksville, drought during month injurious to cotton and late corn; Denison, corn, cotton and vegetables suffering greatly; Pilot Point, 16th, vegetation drying up for want of rain, relieved by heavy thunder-storm on the 18th. Virginia—Wytheville, drought ended on the 16th. Iowa—Nora Springs, latter part of month corn and potatoes suffering. Wisconsin—Waupaca, during month wells failing, brooks drying up, swamps dry, crops damaged, hay, half crop, wheat and oats, half to three-quarters of a crop, potatoes, small amount, no wild fruits, no apples. Dakota—Olive, 15th. Ohio—Cleveland, 9th.

Hail-storms.—Hail-storms have been reported as follows: 1st, Kan., Conn., Mo., N. Y., N. J., Ill., Dak., Pa.; 2nd, Va., N. C., Ill., Kan.; 3rd, Del., N. Y., Pa.; 5th, N. Y., Fla., Ind., N. J., Ohio, Vt., Va., Ga., Dak., Pa., Pembina, D. T.; 7th, Mich.; 8th, Wyoming Ter., Iowa, N. M.; 9th, Conn.; 10th, Wy. Ter., Me., Ind.; 11th, Texas; 13th, N. J., N. M.; 15th, N. C.; 17th, Kans.; 21st, Col.; 22nd, Va., N. M.; 24th, Wy. Ter.; 25th, Col.; 26th, Col., Mo., Dak.; 27th, Pa., Dak.; 28th, N. Y.; 29th, N. M.; 30th, N. Y., Dak.

Large hail-stones.—1st, Conn., Southington, 1 inch in diameter; N.Y., Farmingdale, size of pigeon's eggs; N. J., Barnegat, 3 inches in circumference; Westown, stones ½ to 1¼ inches in diameter; path of storm, 1000 yards wide; course, N. E. by N.; depth of hail, ½ to 5 inches; destroyed all vegetable growth, killed one cow, several pigs and chickens, &c. 2nd, Ashefield, N. C., stones as large as pigeon's eggs. 3d, Florida, Mayport, ½ inch in diameter; N. Y., Adams, 2¼ inches in diameter. 5th, Ft. Rice, D. T., 3 inches in diameter; Ohio, Morristown, as large as hen's eggs. 7th, Mich.; Marquette, one hail-stone measured nine inches in circumference—most were nearly egg-shape. 6th, N. Y., Rodman, 9 inches in circumference. 13th, N. J.; Atlantic City, ½ inch in diameter. 15th, N. C.; Greenville, as large as pigeon's eggs. 22nd, Santa Fe, as large as pigeon's eggs. 30th, on the Yellowstone, as large as a man's clenched hand, perforating the tepees of the Crow Indians and killing a large number of ponies; at Bismarck, stones as large as pigeon's eggs.

Snow.—The 4th, at Summit, Col., was celebrated by a snow-ball party, on snow shoes, which afterward resolved itself into a flower-gathering party, the situation admitting of persons standing on the snow three feet deep, and picking a large variety of Alpine flowers from the uncovered ground beyond the snow. On the 27th, 28th and 29th, snow fell at Pike's Peak.

Rainy days.—The number of days on which rain has fallen, as recorded by Signal Service observers, ranges as follows: New England, 10 to 20 days; Middle Atlantic, 13 to 18; South Atlantic, 9 to 14; East Gulf, 8 to 14; West Gulf, 7 to 13; Tennessee and Ohio valley, 10 to 18; Lower Missouri valley, 6 to 14; Upper Mississippi valley, 6 to 10; Upper Lake region, 10 to 18; Lower Lake region, 10 to 14; Rocky Mountain stations, 1 to 19; California, 0 to 1; Oregon, 5.

Cloudy days.—The number of cloudy days reported during the month by Voluntary Observers and Army Surgeons ranges about as follows: New England, 6 to 19 days; Middle Atlantic States, 5 to 20 days; South Atlantic States, 3 to 14 days; East Gulf States, 3 to 5 days; West Gulf States, 2 to 16 days; Tennessee and Ohio valley, 5 to 13 days; Lower Missouri valley, 2 to 23 days; Upper Mississippi valley, 2 to 6 days; Lake region, 2 to 22 days.

Rain from a cloudless sky was observed at Bangor, Me., on the 17th.

RELATIVE HUMIDITY.

The average relative humidity for the month ranges about as follows: New England, 65 to 85; Middle Atlantic States, 58 to 86; South Atlantic States, 65 to 78; East Gulf States, 62 to 79; West Gulf States, 65 to 70; Tennessee and Ohio valley, 67 to 70; Lower Missouri valley, 62 to 68; Upper Mississippi valley, 62 to 69; Upper Lakes, 62 to 72; Lower Lakes, 61 to 70; San Diego, 74. High stations, uncorrected for altitude, report as follows: Mt. Washington, 86; North Platte, 47; Cheyenne, 31; Denver, 32.

WINDS.

In General.—The prevailing winds at Signal Service stations are shown by arrows on chart No. II, from which it will be seen that southerly winds greatly predominated, tending to southeast west of the Mississippi; and to southwest along the Atlantic coast and Lake region.

Total Movements.—The largest total movements are as follows: Mt. Washington, 14,903 miles; Cape Lookout, 12,022; North Platte, 11,145; Pike's Peak, 11,090; Cape Hatteras, 10,176; Kittyhawk, 9,619; Breckenridge, 9,431.

The Smallest Movements are: Shreveport, 1,380; Nashville, 2,707; Augusta, 2,182; Lynchburg, 2,440.

The Highest Velocities, in miles per hour, have been: 1st, Sandy Hook, 73; 2nd, Pike's Peak, 50; 19th, Cape Lookout, 60; 25th, Mt. Washington, 65; 28th, Washington, D. C., 60; 30th, North Platte, 84 miles.

Local storms, tornadoes, &c., have been reported, as follows: (unless specially noted, it is understood that the following list of high winds include only local storms, and not such gales as prevailed simultaneously over a large region:) 1st, Rochester, N. Y., reports considerable damage by storms to houses, fruit trees and standing grain; North Volney, N. Y., severe wind and hail-storms, doing much damage; Wappinger's Falls, N. Y., tornado, damaging buildings and blowing down trees; a severe wind-storm at Coatsville, Pa., during which a number of houses were destroyed; tornadoes at Ercildoun, Chester Co., and Parkersburg, Pa.; at Waverly, Johnson Co., near St. Paul; Jolly, Ind.; Richmond, Ky.; Gilsum and Sullivan, Chester Co., N. H.; terrific storm at Marlborough, N. Y., much damage done; heavy thunder-storm at Lawrenceville, Pa., damage $30,000. 2nd, tornadoes at Kingsburg, Ind. A destructive tornado occurred at Elkhart, Indiana. It is stated that the day had been unusually warm with light breezes; about 4:30 p. m., there were two storms moving in nearly parallel paths to the east, one from the southwest, the other from the northwest. About 5:30 the upper stratum of air seemed agitated and the higher clouds moved from opposite directions towards each other; below were some ash colored clouds which flew from all directions towards a common centre. At this centre the tornado struck the ground with a black column of cloud about forty rods wide, demolishing everything in its path. It followed the bank of the St. Joseph river for nearly two miles, then lifted and sank again about two miles to the southeast, striking another stream. The centre of the tornado was over the river, as shown by the trees, buildings, etc., falling towards the south. Many persons in the path of the tornado noticed a smell of sulphur. Some say the odor was the same as in the battery room of a telegraph office. As is frequently the case, this tornado was followed by a very severe thunder-storm. This same evening, (2nd,) at 6 p. m., a tornado passed near Goshen, Ind., tearing down houses and trees, and killing several people. Goshen lies about ten miles southeast of Elkhart, and it was probably the same tornado that visited both places. During the 1st and 2nd Illinois, Indiana and Ohio were visited by an unusual number of tornadoes, destructive to life and property, occurring in advance (southeast quadrant) of depression chartered as No. II, on Map I of this Review. 3rd, tornadoes at Grantsville and Baltimore, Md., described as a very heavy storm, chimneys and trees blown down, wind must have reached 50 or 60 miles, in elevated positions; damage to church $1,000. Portsmouth, N. C., remarkable wind-squall, or whirlwind, at 3 p. m., driving sand blasts before it, uprooting trees, destroying fences and out-buildings, sucking water from all ponds, and being followed by thunder-storm. 5th, Butler Co., Ohio, tornado struck the ground in Liberty township, appearing to drop down from above in the form of a dense black cloud, bounding almost immediately, it struck again about a mile and a half distant in a southeasterly direction, uprooting trees, twisting off their trunks, demolishing houses and barns, destroying grain in the shock, growing corn, and sweeping away fences and orchards, disappeared beyond West Chester, near Pisgah. Severe tornado swept over Morrow Co., Ohio, path twelve miles long and one mile wide. Severe storm in southern part of Alleghany co., and a violent rain storm passed over Berks Co., Pa. Severe hail-storm at Charlottsville, Va. Jacksonsburg, Ohio, hurricane from WNW. to ESE., damaging buildings, crops and trees; as it passed through a forest thousands of small balls were seen about 100 feet from the ground, giving out a pale flame. Wytheville, Va., hurricane twisted off, near the base, 6 forest trees (5 oaks and one walnut) from 1½ to 2 feet in diameter. Tybee Island, two miles west of station, at 5:35 p. m., waterspout bursted, making a whizzing noise, column about 100 feet high and 3 feet in diameter. Severe gale at Wautoma, Wis., unroofing buildings, uprooting trees and destroying crops. 6th, heavy gale at Fernandina, Fla. 7th, Breckenridge, Minn., wind blowing 90 miles per hour for about 3 minutes, unroofing and demolishing buildings, leveling fences, twisting off tree-trunks, &c., Pelham, N. Y., tornado, tearing trees up by the roots; much damage to orchards. 7th, a very destructive tornado occurred at Pensaukee, Wis. It moved from the northwest to southeast; its track was three miles long and one thousand feet wide; it lasted about two minutes; eight persons are known to have been killed; many were wounded; the damage to property was estimated at $300,000. 9th, Westfield, Mass.—storm doing heavy damage, houses blown down, fences scattered, crops destroyed, and several lives reported lost. Tornado, with violent wind, rain and hail at Galt, Ont., at 5 a. m. 9th, and 27th, Poughkeepsie, N. Y., severe wind storms. 10th, New Orleans, La., at 6:55 p. m., a water-spout was observed apparently over the Lake, moving towards the NW., and followed by a heavy thunder-storm; Tybee Island, Ga., two water-spouts observed 4 miles north of station at 6 p. m.; they were about 1 mile apart, columns long and of short duration. 11th, Tybee Island, Ga., 8 miles NW. of station, in Jones' river, two water-spouts at 11 a. m., columns appeared nearly one mile high and about two feet in diameter, distance apart about four rods, and lasting about fifteen minutes; at Indianola, Tex., 7:35 a. m., water-spout formed in bay about two miles from shore, having an apparent diameter of seventy-five feet; travelled furiously for seven miles, and then broke, followed by rain at 7:35 a. m.; Savannah, Ga., waterspout observed a short distance south of the city in afternoon. 15th, Fort Whipple, Va., violent thunder-storms, lightning striking and shattering flag-staff. 16th, tornado in Duchess and Cumberland counties, N. Y. 27th, severe gale with hail and rain at Richland Station, Pa.; heavy wind storm at Poughkeepsie, N. Y. 19th, tornado at Elizabeth, N. Y. 26th, Ft. Sully, Dak., a hurricane described as follows: at 5 p. m., a few cumulo-stratus clouds appeared in the horizon; at 5:30 cumulo-stratus were forming over the station, spreading rapidly in every direction; at 6 p. m., the sky was entirely

cove ed by swiftly moving clouds; at 6:20 the wind suddenly veered from SE. to W.; the wind blew in gust ; and at 6:25 p. m. the anemometer, which previously registered 84 miles per hour, was torn from the roof, the chimneys quickly followed, and the building trembled like a leaf; the instrument shelter was blown down, as well as every board fence in and about the post; two houses were unroofed. The stockade, built of heavy timber and braced on both sides, was leveled to the ground, and one of the block-houses was moved eighteen inches; at 6:30 p. m. rain, hail and lightning commenced; at 7:40 p. m. the storm ceased. The highest wind was not registered; it was estimated at 100 miles per hour.

VERIFICATIONS.

The detailed comparisons of the tri-daily weather indications, with the telegraphic weather reports for the succeeding twenty-four hours, shows a general percentage of omissions of 0.05 per cent., and of verifications of 84.1 per cent.; out of 3,702 predictions, 2,521, or 68.1 per cent. have been fully verified; 382, or 10.3 per cent. have been three-fourths verified; 547, or 14.8 per cent. have been one-half verified; 126, or 3.4 per cent. have been one-fourth verified and 126 or 3 4 per cent. have failed. The percentages for the four elements have been: weather, 89.1; wind, 81.8; temperature, 86.6; barometer, 78.8. The percentages of verifications by geographical districts, have been: New England, 84.5; Middle Atlantic States, 84.0; South Atlantic States, 82.1; East Gulf States, 81.9; West Gulf States, 85.6; Lower Lake region, 84.6; Upper Lake region, 82.9; Tennessee and Ohio valley, 84.4; Upper Mississippi valley, 86.4; Lower Missouri valley, 84.6

Cautionary Signals.—During the month 29 Cautionary Signals have been displayed at stations on the Gulf and South Atlantic coasts and on the Lakes. Of these 23 or 79.3 per cent. were justified by subsequent high winds within one hundred miles of the stations for which they were ordered, and 6 or 20.7 per cent. were not justified so far as known. Eighty-four instances of high winds, where no signals were displayed, have also been reported from these stations. Telegraphic communication with the North Carolina coast stations has continued interrupted during the month.

NAVIGATION.

Stages of Water.—In the table on chart No. III, are given the highest and lowest readings on the river gauges for the month. A gradual fall has occurred in all the rivers, throughout the month, with the following exceptions:—slight rises in the Missouri at Omaha, on the 8th, 15th and 16th; in the Mississippi at St. Paul, from the 1st to 8th; at La Crosse, to the 12th, and from Dubuque to St. Louis until about the 17th; in the Cumberland, at Nashville, from the 18th to the 20th; in the Ohio, at Pittsburgh, on the 5th, 10th and 11th, 19th to 21st, and 28th to 31st; at Cincinnati, from the 6th to the 11th, and the 24th to the 27th. at Louisville, from the 7th to the 11th, and the 25th to the 28th. The Savannah rose at Augusta on the 20th, 21st and 25th. The rise in the Missouri, at Omaha, on the 8th, was due to the water cutting a new channel across the bend and turning the main channel. On the 1st, the water in Lake Erie is reported to have risen several feet at Buffalo.

Ice bergs.—None reported.

TEMPERATURE OF WATER.

In General.—The temperature of water, as observed in rivers and harbors, is shown in the table on chart No. II. The average temperatures have been lowest at Eastport, 43°; and at Marquette, 49°. They have been highest at Galveston and Augusta, 87°; Montgomery, 85°; Mobile, 86°; Charleston, Knoxville, Savannah and Wilmington, 84°.

Maximum and Minimum Temperatures.—The highest maxima have been: Galveston, 91°; Augusta, 90°; Montgomery and Mobile, 89°. The lowest minima have been: Eastport, 40°; Duluth, 43°; and Marquette, 46°.

Ranges of Temperatures. The least ranges have been: San Francisco, 2°; Savannah, 3°; Grand Haven and Wilmington, 4°; Charleston, Escanaba, Eastport and Mobile, 5°.

ATMOSPHERIC ELECTRICITY.

Thunder-storms were reported at stations as follows: 1st. N. Y., R. I., Conn., Del., Ill., Iowa, Kan., Me., Md., Mass., Mo., Neb., N. H., N. J., Ohio, Penn., Vt., W. Va, Dak.; 2nd. Mich., Can., Ill., Ind., Iowa, Me., Mo., Neb., N. Y., Ohio, S. C., Va., Vt., Penn., Kan.; 3rd, N. Y., Va., Conn., Del., La., Md., Mich., N. J., N. C., Ohio, Penn., Ill., W. Va., Ind.; 4th, Ill., Ind., Mass., Minn., N. J., N. Y., Ohio, Texas, Va., Wis., Tenn., Ky.; 5th, N. Y., Can., Ga., Ill., Ind., Kan., Me., Md., Mass., Mich., N. J., N. C., Ohio, Penn., S. C.,

Texas, Vt., Va., Wis., W. Va., Fla., Ky.; 6th, Dak., R. I., Ala., Conn., Del., Ga., Ill., Ind., Me., Md., Mass., N. J., S. C., Tenn., Vt., Fla.; 7th, Can., Iowa, La., Minn., Wis., Mich., Fla., Kan.; 8th, N. Y., R. I., Wy. Ty., Ill., Ind., Iowa, Kan., Mo., Neb., Ohio, Vt., Wis., Fla.; 9th, Conn., Ind., Kan., Me., Mass., N. H., N. J., N. Y., Ohio, Penn., Vt., Va., Wis., Ill., Ky., Wy. Ty., Minn., Ind. Ty., Mo.; 10th, Wy. Ty., Conn., Ga., Ind., Me., Md., Mass., N. J., N. Y., N. C., Ohio, Texas, Vt., Va., Tenn., Minn., W. Va., Ala., N. H., La.; 11th, Dak., Del., Iowa, Md., Neb., N. J., Penn., S. C., Texas, Va., Wy. Ty., Ga., N. C.; 12th, Can., Dak., N. Y., Vt., Mich.; 13th, Dak., Conn., Mass., Minn., N. J., N. Y., S. C., Md., Col., R. I., Texas, Penn.; 14th, Dak., Me., Neb., Tenn., Texas, Mass., Mich.: 15th, S. C., Ill., Iowa, Kan., Neb., N. C., Tenn., Wis., N. J., Vt., Mich., Texas, Mo.; 16th, Mich., N. Y., Conn., Ill., Ind., Iowa, Kan., Mass., Mo., Neb., Ohio, Tenn., Texas, Va., Wis., Vt., W. Va., Miss.; 17th, N. Y, Conn., Iowa, Kan., Me., Mass., Mo., Neb., N. H., N. J., N. C., Penn., Vt., Va., Wis., Mich., Ind. Ty., Md.; 18th, Mich., Can., Ill., Ind., Kan., N. J., N. Y., Ohio, Penn., Tenn., Texas, Va., Md., Ky., Ind. Ter.; 19th, Mich., N. Y., Conn., Md., N. J., N. Y.; N. C., Penn., S. C., Va., W. Va., Ga., N. H., Texas; 20th, Mich., Nev., N. J., N. C., Penn., S. C., Vt., Va., Dak., Cal.; 21st, Ga., N. C., S. C., Nev.; 22nd, N. C., Tenn., Va., Wis., Mich., W. Va.; 23rd, N. J., N. C., Va., W. Va., Tenn., Fla.; 24th, Wy. Ty., Ind., La., Mo., Neb., Ala., Va., Texas; 25th, Dak., Mich., La., Mo., N. C., Ohio, Tenn., Va., Ill., Me., W. Va., Ala., Texas; 26th, Ala., Dak., Ill., Iowa, Me., Mich., Ohio, Penn., Vt. Va., Wis., N. C., Texas, Mo., Neb., Kan.; 27th, Dak., Neb., Ala., Ark., Conn., Del., Ill., Ind., Iowa, Kan., La., Me., Mo., N. J., N. Y., Ohio, Penn., Va., W. Va., Mich., Wis., Ind. Ty., Texas; 28th, Va., Ill., Ind., Iowa, Kan., Md., Miss., Neb., N. J., N. Y., N. C., Ohio, Penn., Ky., Ind. Ty., W. Va., Tenn., Texas, La.; 29th, Dak., Ga., Kan., Md., Mass., N. J., N. Y., N. C., Ohio, Penn., Tenn., Fla., Va., Ind. Ty.; 30th, Dak., Neb., Ark., Conn., Kan., N. J., N. Y., N. C., Penn., Va., S. C., Ala., Ga.; 31st, Dak., Ill., Iowa, Mo., Neb., N. J., N. Y., S. C., Vt., Minn.

Distant thunder or lightning was reported as seen from stations in the respective States as follows: 1st, Dak., Conn., Del., Ga., Ill., Ind., Iowa, Kan., Ky., Me., Md., Mass., Mo., Neb., N. J., N. Y., Ohio, S. C., Tenn., Va. Vt.; 2nd, Ala., Del., Ga., Ill., Ind., Iowa, Me., Md., Minn., Mo., N. C., Ohio, Tenn., Va., Wis., W. Va.; 3d, Conn., Del., Fla., Ga., Ind., Iowa, La., Md., Miss., Mo., N. J., N. Y., N. C., Ohio, Penn., Va.; 4th, Ga., Ill., Ind., Iowa, Ky., Mich., Md., N. C., Ohio, S. C., Va., Wis., W. Va.; 5th, Dak., Del., Ill., Ind., Iowa, La., Mich., Mo., N. J., N. Y., N. C., Ohio, Pa., S. C., Tenn., Vt., Va.; 6th, Conn., Dak., Ga., Ill., Mo., N. J., N. Y., Texas, Vt., Wy. Ty.; 7th, Dak., Ind., Ill., Iowa., Kan., La., Mich., Minn., Mo., Neb., N. Y., Wis., Wy. Ty.; 8th, Ga., Ill., Ind., Iowa, Kan., Mass., Mich., Mo., N. Y., Ohio, Vt.; 9th, Fla., Ga., Ill., Iowa, Me., Md., Mass., Mich., N. Y., Ohio, Pa., Tenn., Texas, Vt., Va.; 10th, Ind., Ky., La., Me., Mass., Mich., Miss., N. J., N. Y., N. C., Ohio, Texas, Utah, Vt., Va.; 11th, Ala., Col., La., Me., N. J., N. C., Tenn., Va.; 12th., Col., Dak., Fla., La., Mich., N. Y., Tenn., Texas, Vt.; 13th, Col., Conn., Dak., Iowa, Kan., Md., Mass., Minn., Neb., N. J., N. Y., R. I., Texas; 14th, Ala., Dak., Iowa, La., Minn., Mo., Texas; 15th, Ala., Ill., Iowa, Kan., La., Mich., Minn., Neb., N. M., N. C., Tenn., Texas; 16th, Ind. Ty., Ind., Iowa, Kan., Md., Mich., Mo., Neb., N. Y., N. C., Ohio, Pa., Texas, Va.; 17th, Conn., Del., Ill., Iowa, Kan., Me., Mass., Mich., Mo., Neb., N. Y., N. C., R. I., Tenn., Vt., Wis.; 18th, Ala., Ill., Iowa, Ky., Mich., Neb., N. Y., Ohio, Pa., Texas, Va.; 19th, Ala., Ind. Ty., Ind., Iowa, La., N. J., N. Y., N. C., Pa., R. I., Texas, Va.; 20th, Cal., Col., Ind., N. J., Pa., Vt.; 21st, Ind. Ty., Mich., N. M., S. C.; 22nd, Kan., S. C.; 23d, Ga., Utah; 24th, Cal., Ga., Ind., Iowa, Ky., Mo., Neb.; 25th, Dak., Ill., Mo., N. C., Ohio, Texas; 26th, Dak., Ill., Ind., Iowa, La., Me., Md., Mich., Neb., N. Y., Ohio, Texas, W. Va., Va.; 27th, Ala., Conn., Dak., Ind. Ty., Ill., Ind., Iowa, Kan., Md., N. J., N. Y., N. C., Ohio, Pa., Texas, Va; 28th, Conn., Ill., Ind., Ky., Md., Mich., N. J., N. Y., N. C., Ohio, Pa., Tenn., Texas, Va.; 29th, Dak., Ga., Ind., Ky., Neb., N. Y., N. C., Ohio, Penn.; S. C., Tenn., Texas; 30th, Conn., Dak., Fla., Ga., Ind., Ind. Ty., Md., N. H., Neb., N. J., N. Y., Pa., Wy. Ty., Va.; 31st, Dak., Ga., Ill., Iowa, Kan., Me., Mo., Neb., N. J., N. C.

Auroras were observed as follows: 1st, Williamsport, Pa. 2nd, Williamsport, Pa. 3rd, Bangor, Me. 5th, Olympia, Washington Territory. 6th, Vevay, Ind., Wappinger's Falls, N. Y. 7th, Sandwich, Ill., Bangor, Me.; Boston, Mass.; Duluth, Minn.; Pembina, D. T. 8th, Mt. Forest, Can.; Minneapolis. 9th, Clear Creek, Neb.; Alpena and Escanaba, Mich.; Fort Brady, Mich. 10th, Escanaba, Mich. 11th, Mt. Forest, Can. 21st, Burlington, Vt. 22nd, Bangor, Me. 24th, Mt. Forest, Can. 25th, Mt. Forest, Can. 28th, Vevay, Ind. 30th, West Charlotte, Vt.; Fort Brady, Mich. 31st, Escanaba, Mich.; Fort Brady, Mich.; Minneapolis, Minn.

Ground Currents.—Disturbances on lines of telegraph have been reported as follows: at Wappinger's Falls, N. Y., on the 17th; Santa Fe, N. M., 13th, 16th, 19th, 20th, so strong in some cases as to materially hinder operations of telegraph lines.

OPTICAL PHENOMENA.

Solar halos were observed on the 1st in Ill., N. Y., Ohio, Kan. 2nd, Conn., Ky., Me., N. Y., Pa., R. I. 3rd, Ky., Me., Mass., N. H., N. Y., R. I. 4th, La., Neb., Ohio, Mich. 5th, Ky., Me., Mass., N. Y., R. I.

6th, Iowa, Mass., Ohio, Utah, Me. 7th, Iowa, N. Y. 8th, N. Y. 11th, Fla. 12th, Fla. 13th, Iowa, Neb., Cal., Miss., Fla 14th, Tenn., Ky. 15th, Conn., W. Va., N. C., N. Y., Fla., N. H. 16th, Iowa, Me., R. I. 17th, Ill., Ind., Ga., S. C. 18th, Ind., Mass., S. C., Pa., Ala., N. Y., La. 20th, Ill. 22nd, Ind., Mo., Ohio, Me., Ala. 23rd, Mich., Ohio, Ky., R. I. 24th, N. J. 25th, Ill., Mich., S. C., Fla. 26th, Ohio, Dak., S. C. 27th, N. C. 28th, Iowa, Neb., N. C., S. C. 30th, N. Y., Ohio, Ind., Minn., Dak.

Lunar halos were observed on the 1st, Ill.; 3rd, Va.; 6th, Utah; 10th, Mo.; 14th, Ind., Mo., Nev.; 15th, Ind., N. C., Va., Ohio; 16th, Va., Conn., Minn., Texas; 17th, Ind., Ohio, Tenn., Ky., Texas; 18th, Del., Pa., N. J., Va., Ohio; 19th, N. C.; 20th, Me., Fla.; 21st, Tenn., Mo.; 22nd, Ind., Va., S. C., Ky., Ohio, Minn., Tenn.; 23rd, Ohio, Mass., Ky., Ind., R. I., Minn., Va.; 24th, Ind., Ohio, Tenn., Minn., Kan.; 25th, Ill., Mass., S. C., Dak.; 26th, Pa., Tenn., Ky., N. C., Ala.; 27th, N. C., Mo., Ohio; 28th, Ky., Neb., Pa.; 29th, Can., Ohio, N. C., Va., Conn.; 30th, Dak.

Mirage was observed at Westport, Mass., 15th; Genoa, Neb., 31st; about 12 or 15 miles from Denver, Col., down the valley of the Platte, 30th; Denver, Col., 29th, 30th, 31st; Duluth, Minn., 14th; New London, Conn., 13th; Tybee Island, Ga., 26th, 27th, 28th.

Rainbows.—Four were observed at Vevay, Ind., on the 5th. "The rainbow proper presented a full and well-defined arch, extending from horizon to horizon; interior were three well and sharply-defined images, the breadth of each decreasing towards the centre. The exterior ring was but faintly defined in prismatic colors. It is noteworthy that not a drop of rain fell during the occurrence."

MISCELLANEOUS PHENOMENA.

Zoological—Botanical.—Harvesting began as follows: *Barley*, 6th, Monticello, Iowa; 11th, Oregon, Mo. *Oats*, 13th, Cresswell, Kan.; 18th, Jacksonburg, Ohio; 19th, Oregon, Mo.; 20th, Wappinger's Falls, N. Y.; 20th, 21st, Riley, Kan. *Rye*, 2nd, Oregon, Mo.; 6th, Monticello, Iowa. *Wheat*, (winter,) 2nd, (spring,) 16th, Oregon, Mo.; 12th, Nichols, N. Y.; (spring,) 13th, Cresswell, Kan.; (spring,) 21st, Monticello, Iowa. *Hay*, 3rd, Monticello, Iowa, and Oregon, Mo.; 11th, Palermo, N. Y.; 14th, New London, Conn.; 19th, Jacksonburg, Ohio.

Fruits.—Blooming and ripening, are reported as follows: *Blackberries*, ripe 4th, Independence, Kan.; 7th, Vineland, N. J.; 12th, Wappinger's Falls, N. Y.; 21st, Jacksonburg, Ohio. *Cherries*, ripe, 4th, Cornish, Me.; 12th, West Charlotte, Vt. *Currants*, ripe, 6th, Wappinger's Falls, N. Y. *Peaches*, ripe, 6th, Independence, Kan.; 16th, (two weeks late) Carbondale, Ill. *Raspberries*, ripe, 1st, Monticello, Iowa; 4th, Jacksonburg, Ohio. *Apples*, ripe, 7th, Vineland, N. J.; 12th, Fort Madison, Iowa; 18th, Oregon, Mo.; 21st, Wappinger's Falls, N. Y. *Watermelons*, ripe, 16th, Carbondale, Ill. *Figs*, ripe, 4th, New Orleans, La. *Apricots*, ripening, 13th, Oregon, Mo.; ripe, 20th, Wappinger's Falls, N. Y. *Gooseberries*, ripe, 19th, Wappinger's Falls, N. Y.

Flowers and Trees.—*Tiger Lilies*, blooming, 14th, and *Common Lilies*, 16th, Monticello, Iowa. *White Elder*, flowering, 5th, Cornish, Me. *Purple Vervain*, flowering, 1st, and *Common Milkweed* and *Pleurisy Root*, 2d, Oregon, Mo. *Sweet Elder*, blooming, 2d, Palermo, N. Y.

Birds.—9th, Contoocookville, N. H., *Quail* heard—uncommon occurrence, happening not more than once in a season.

Insects.—*Katy-dids*, first heard, 12th, Anna, Ill.; 22d, Ringgold, Ohio; 26th, Hennepin, Ill. and Bethel, Ohio; 28th, Plattsmouth, Neb. and Bloomfield, Wis.; seen hatching, 18th, Wappinger's Falls, N. Y. *Chintz Bugs*, 15th, very numerous at Guttenburg, Iowa; "destroying thousands of bushels of wheat," Wautoma, Wis., damaging wheat, which yields only two-thirds of average crop. *Harvest Flies*, 19th, Oregon, Mo., casting pupae coat; 25th, Woodstock, Vt.; 26th, Somerset, Mass. *Fireflies*, 21st, last seen at Linden, N. J. *Mass Flies*, 15th, Ringgold, Ohio. *Grasshoppers*, Dakota Ty., Morriston, destroying crops, 6th and 21st; Yankton, flying west and northwest, 3d, southeast, 17th and 28th. Nebraska, Genoa, flying north, 5th, 6th, 7th, 11th, 12th, 13th, 21st, 22d and 25th, descending, 29th, flying south, 30th and 31st; Plattsmouth, flying north, 22d to 27th; none lighting; Clear Creek, flying southeast, 1st, northerly, 3d, 4th, 5th, 6th and 7th, lighting, 9th, flying north, 10th, 12th, 13th and 14th, lighting, 15th, flying, 22d, 23d, 28th, 29th and 30th. During the month they have injured wheat crop, three-fourths, barley, one-half, oats a small percentage, corn but little. North Platte, 3d, a few flying westward; Omaha, an immense swarm flying northwest, 11th, 12th and 31st, none lighting. Minnesota, St. Paul, flying southeast, 20th. Dakota, Bismarck, flying from southeast to northwest, 21st and 24th; north, 25th, 26th and 27th; abundant on ground, 28th and 29th; destroying wheat, 31st. Minnesota, Breckenridge, flying north and northwest, 3d, 4th, 6th, 11th, 13th, 14th, 19th, 20th, 22d and 30th; some damage done during month. Kansas, Fort Larned, flying north, very high; Cresswell, flying from northeast to southwest; Denver, on the 31st, reports no flying grasshoppers yet and the native ones doing no damage. Missouri, Oregon, beginning to fly, 1st, flying south,

8th, northwest. 12th. Iowa, Council Bluffs, flying, 21st and 22d, resting, 23d; Fort Madison, flying high, not lighting, 29th, 30th and 31st; Boonsboro, flying north, 21st; Vail, leaving, 10th, lighting and devouring buckwheat, green oats, &c., 29th and 30th, all left in a body, 31st, little damage. *Locusts*, (red-legged,) Michigan, Oakland and Iona counties, damaging crops, 6th. Utah Territory, flying south and east, 26th, lighting, 27th, 28th, 29th and 30th, "millions," 31st. Nebraska, North Platte, 31st, reports the absence of Rocky Mountain Locusts.

Polar Bands.—1st, Carthagena, Ohio. 3rd, Wytheville, Va. 4th, N. H. 5th, Wood's Holl, Mass. 8th, Wytheville, Va. 9th, Iowa City, Iowa. 11th, Gardiner, Me., Iowa City, Iowa. 12th, Wytheville, Va., Wood's Holl, Mass. 13th, Iowa City, Iowa. 14th, Iowa City, Iowa. 15th, Jacksonsburg, Ohio. 17th, Tabor, Iowa, Freehold, N. J. Iowa City, Iowa. 18th, Gardiner, Me. 22nd, Auburn, N. H., Freehold, N. J., Carthagena, Ohio. 23rd, Gardiner, Me., Duluth, Minn. 25th, Jacksonsburg, Ohio. 27th, Carthagena, Ohio. 28th, Guttenburg, Iowa, Iowa City, Iowa. 30th, Carthagena, Ohio, Wytheville, Va.

Sunsets—The characteristics of the sky, as indicative of approaching fair or foul weather, have been observed daily, at sunset, at all Signal Service stations. The monthly means from 95 stations show that 52 doubtful cases or blanks were recorded, and that out of the remaining 2,867 cases 2,309 or 80.5 per cent. have been followed by the expected weather.

Marsh Fires, reported as prevailing during the month in Eaton Co., Michigan.

Forest Fires near Bangor, Me., 24th; at Sacramento, Cal., from the 24th to the 31st; Stockton, Tex., 13th.

Meteors.—Were observed as follows: 1st, Gilmore, Tex.; Savannah, Ga. 2nd, Monticello, Ia.; Spartansburg, S. C., "blazed out in the zenith; passed rapidly westward and exploded about 30° above the horizon, separating into many pieces;" Asheville, N. C.; Savannah, Ga.; Fayette, Miss. 4th, Woodstock, Md.; Waterburgh, Vt. 6th, Monticello, Ia. 7th, Como, Ills; Wappinger's Falls, N. Y. 8th, Brookhaven, Miss.; Mt. Auburn, Ohio; Savannah, Ga. 9th, Asheville, N. C. 10th, Woodstock, Md.; Ateo, N. J. 11th, Leavenworth, Kansas. 12th, Monticello, Iowa; Detroit, Mich.; Montgomery, Ala.; Savannah, Ga. 15th, Woodstock, Md.; Carthagena and Jacksonburg, Ohio; Cape Lookout, N. C. 20th, Wytheville, Va. 22nd, Chambersburg, Pa. 23rd, Sacramento, Cal. 24th, Council Bluffs, Iowa; Duluth, Minn. 25th, Vevay, Ind.; Woodstock, Md.; Tybee Island, Ga. 27th, Brookhaven, Miss.; Savannah and Tybee Island, Ga.; 28th, Vevay, Ind.; Hector, N. Y.; Mt. Auburn, Ohio; Boise City, Idaho. 29th, Afton, Iowa; Brookhaven, Miss.; Tybee Island, Ga.; Corsicana, Texas. 30th, Contoocookville, N. H.; Milton, Fla.; Vevay, Ind.; Monticello, Iowa; Cleveland, Ohio; Utica, Wis.; Duluth, Minn.; Leavenworth, Kansas; Boise City, Idaho. 31st, Vevay, Ind.; Brookhaven, Miss., Bellefontaine and Cleveland, Ohio; Newcastle, Pa.; Indianapolis, Ind.; North Platte, Neb.

Zodiacal Light.—Southington, Conn., 7th; Monticello, Iowa, 12th, 13th, 14th, 29th, 30th; Jacksonsburg, Ohio, 10th, 15th, 25th; Savannah, Ga., 1st, 8th, 9th, 28th.

Earthquakes.—9th, Sacramento, Cal.; lasting one minute; oscillations E. and W.; buildings sensibly shaken. 14th, Memphis, Tenn.; vibrations from SW. or W. to NE. or E.; buildings rocked somewhat. 15th, Carbondale, Ill.; consisting of three shocks, which appeared to come from the west, continuing about five seconds. 17th, River Du Loup, Quebec, Can.

Volcanoes.—A volcanic eruption supposed to have originated in Cotopaxi, Ecuador, South America spread desolation over the valleys of Chile and Tumbaca. A frightful noise was heard at Latacunga, followed by tremendous floods in the valleys of Cutuchi, San Felipe, Yanyanco and Hacienda, carrying away cattle and bridges. All the haciendas on both sides of the river suffered enormously and the destruction is said to have been terrible and complete.

SOLAR PHENOMENA.

Sun-spots.—The following observations, made by Mr. D. P. Todd, upon the spots on the sun, have been kindly communicated to the Signal Service by Rear-Admiral John Rodgers, U. S. N., Superintendent of the Naval Observatory:

July, 1877.	No. of new—		Reappeared by solar rotation.		Disappeared by solar rotation.		Total number visible.		Remarks.
	Groups	Spots.	Groups	Spots.	Groups	Spots.	Groups	Spots.	
1st, 10 a. m.	0	0	1	2	0	0	2	4	
2nd, 10 a. m.	0	1	0	0	1	2	1	3	
4th, 10 a. m.	0	0	0	0	0	0	1	3	
5th, 6 p. m.	0	0	0	0	0	0	0	0	
7th, 11 a. m.	0	0	0	0	0	0	0	0	
8th, 10 a. m.	0	0	0	0	0	0	0	0	
9th, 9 a. m.	0	0	0	0	0	0	0	0	
10th, 6 p. m.	0	0	0	0	0	0	0	0	
11th, 9 a. m.	0	0	0	0	0	0	0	0	
12th, 9 a. m.	0	0	0	0	0	0	0	0	
13th, 9 a. m.	0	0	0	0	0	0	0	0	
14th, 7 a. m.	0	0	0	0	0	0	0	0	
15th, 10 a. m.	0	0	0	0	0	0	0	0	
17th, 6 p. m.	0	1	0	0	0	0	0	1	
18th, 10 a. m.	0	0	0	0	0	0	0	1	
22nd, 2 p. m.	0	0	0	0	0	0	0	0	
24th, 3 p. m.	0	0	0	0	0	0	0	0	
25th, 11 a. m.	0	0	0	0	0	0	0	0	
26th, 11 a. m.	0	0	0	0	0	0	0	0	
31st, 7 a. m.	1	5	0	0	0	0	1	5	

M. Albert Lancaster, Meteorologist Inspector in the Royal Observatory at Brussels, publishes a memoir in the "*Bulletins de l'Academie Royale*" for May, in which he makes a careful examination and comparison of the summer, winter, and annual temperatures at Brussels from 1833 to 1877, in reference to the activity of sun-spots for the same period, and draws the conclusion that the amount of heat thrown by the sun on the earth is greatest when the spots are the least in number, and that the researches of M. Köppen show the contrary during or after a period of maxima of spots; that the *variations* in the distribution of temperature on the globe are due, in great part, if not entirely, to the frequency of spots; that the influence of these spots are shown more clearly in low than in high latitudes; that the Gulf stream offers, after each minimum of spots, the phenomenon of a temperature much above the mean, which renders the winter and summer of Europe exceptionally warm, and that to this increase of temperature in the Gulf stream the northeastern coast of the United States is indebted to contrary north polar currents whose temperature is below the mean. As a result of his examination, he announced that the approaching summer of 1877 would have, in Europe, a temperature above the mean, and in the east of the United States a temperature below the mean.

Dr. W. W. Hunter, the Director General of the Statistical Department of India, has made an investigation of the rain-fall in the Presidency of Madras for a period of sixty-four years, with a view of determining if any relation exists between the number of sun-spots and amount of rain. He finds that in a cycle of eleven years both sun-spots and rain-fall reach their minimum, consisting of the eleventh, first, and second years, and their maximum in the fifth year. He cautiously stated his general conclusions thus: "That while the statistical evidence discloses a cycle of drought in Southern India coincident in a marked manner with a corresponing cycle of sun-spots, it also tends to show that the average rain-fall of the years of minimum rain-fall in the said cycle approaches perilously near to the point of deficiency which causes famine; that the average is, however, above that point, and that, while we have reason to apprehend recurring droughts and frequent famines in these cyclic years of minimum rain-fall, the evidence is so far insufficient to warrant the prediction of a regularly recurring famine.

NOTES AND EXTRACTS.

Prof. E. Loomis communicates to the American Journal of Science the following conclusions:

[*Continued from the Review of June.*]

4. In North America, south of latitude 35°, areas of low pressure are less frequent and generally exhibit a less depression than near latitude 45°, because the area over which a cyclonic movement of the winds prevails is small; and this area is small because if a cyclonic area could be formed having a radius of 1,000 miles with its centre in latitude 30°, its circumference must extend southward to latitude 16°, where the trade winds are steady and seldom interrupted. Such a diversion of the winds toward the north, even if it could be produced, could not be long maintained; so that a large cyclonic area with its centre in latitude 30° is well nigh impossible; and it is impossible that there should be a great depression of the barometer in latitude 30°, except with a wind having a hurricane velocity. This is believed to be the reason why in North America the centres of great storms are generally found north of latitude 40°.

5. The causes which may produce a general movement of the atmosphere toward a central area are (A) unequal pressure as shown by the barometer; (B) unequal temperature; and (C) unequal amount of aqueous vapor. Of these three causes the effect of the first is generally so decided that the influence of the other two causes can only be detected by careful observation; but when the pressure of the air is nearly uniform over a large extent of country, the influence of the other two causes is sometimes very palpable, and their influence is generally seen in a slight deflection of the winds from the direction they would have if wholly controlled by the first cause. I have made a considerable collection of facts illustrating the influence of temperature upon the direction of the winds, which I intend to publish hereafter.

6. A cyclonic movement of a large mass of air is generally attended by an upward motion in certain localities, chiefly on the eastern side of the centre of low pressure, and this upward movement results in rain-fall. The rain-fall is then not generally the original cause of the barometric depression, but rather an incident of the cycloidal movement of the atmosphere. The fall of the barometer during a rain-storm cannot be ascribed to the simple condensation of the vapor of the atmosphere, as some have supposed, since a rain-fall of one or two inches prevailing over an area of 300 miles in diameter near latitude 30° produces scarcely an appreciable effect upon the barometer.

7. The progress of areas of low barometer in all latitudes is determined mainly by the same causes which determine the general system of circulation of the atmosphere; and their normal direction is changed by whatever causes may change the direction of the winds.

8. The heat which is liberated in the condensation of a large amount of aqueous vapor must exert an influence upon the movements of the air, so that while the rain is generally to be regarded not as the original cause but rather as one of the incidents of extensive cycloidal movement, if the rain-area has great geographical extent, it may have a decided influence upon the amount of the barometric depression and upon the velocity with which the storm advances; sometimes accelerating its motions, sometimes retarding it, and sometimes holding it nearly stationary in position for two or three days.

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